

(9) CLAIMS

1. Connected to an output pad of an integrated circuit, an output driver circuit device, having a predetermined power supply voltage nominal level, the device comprising:
 - a MOSFET first stage including a means for amplifying an input signal and an means for outputting an output signal state; and
 - a BiCMOSFET second stage including means for automatically maintaining said output signal at the output signal state when said power supply voltage nominal level is less than a threshold voltage required for said MOSFET first stage to maintain said output signal state.
2. The device as set forth in claim 1 wherein said second stage includes BiCMOSFET components for maintaining said output signal state at a digital logic LOW.
3. The device as set forth in claim 2, comprising:
 - said second stage providing a substantial amount of sink current such that said output signal is said digital logic LOW even when the power supply voltage falls lower than said nominal level.
4. The device as set forth in claim 1 wherein said second stage includes BiCMOSFET components for maintaining said output signal state at a digital HIGH.

1 5. The device as set forth in claim 4, comprising:

2 said second stage providing a substantial amount of source current such that said
3 output signal is said digital logic HIGH even when the power supply voltage falls lower than
4 said nominal level.

5 6. The device as set forth in claim 1 wherein said second stage is a BiCMOSFET
6 auxiliary output driver maintained in a desired state when said power supply voltage
7 nominal level is substantially equal to but no less than said threshold voltage.

8 7. The device as set forth in claim 6 wherein threshold voltage of an output driving
9 connected MOSFET of said BiCMOSFET auxiliary output driver is substantially equivalent
10 to threshold voltage of an output driving MOSFET of said first stage.

11 8. The device as set forth in claim 6 further comprising:
12 means for preventing leakage current in bipolar components from turning said
13 BiCMOSFET auxiliary output driver to an ON state when said power supply voltage nominal
14 level is within design criteria operating range.

15 9. The device as set forth in claim 1 further comprising:
16 said second stage including means for protecting said second stage from
17 electrostatic discharge into power supply nodes.

1 10. The device as set forth in claim 1 wherein maximum amount of drive to said output
2 pad is determined by respective gains of bipolar transistors of said BiCMOSFET second
3 stage and resistance value of a bias resistor therefor.

4 11. An auxiliary output signal driver device for a CMOS output driver circuit for an output
5 pad of an integrated circuit, having a given power supply voltage having an operating range
6 wherein said operating range maintains threshold voltage for MOSFET components of said
7 output driver circuit, said auxiliary output signal driver device comprising:

8 coupled to said output pad, an output node from a series of bipolar transistors, said
9 bipolar transistors having a predetermined bias resistor for determining current flow thereto;
10 and

11 connected to said bias resistor, a MOS transistor for shunting a current that passes
12 through said bias resistor, such that when said power supply voltage is substantially within
13 said operating range the MOS transistor prevents the current from driving a base of a first
14 bipolar transistor of said series, and when said power supply is below said operating range
15 the MOS transistor is not shunting the current that passes through said bias resistor and the
16 current is thereby driving the base of the first bipolar transistor of said series.

17 12. The device as set forth in claim 11 wherein when said MOS transistor is driving the
18 current, said device is providing a substantial amount of sink current such that said output
19 signal is said digital logic LOW even when the power supply voltage falls below said
20 operating range.

1 13. The device as set forth in claim 11 wherein when said MOS transistor is driving
2 current, said device is providing a substantial amount of source current such that said
3 output signal is said digital logic HIGH even when the power supply voltage falls below said
4 operating range.

5 14. The device as set forth in claim 11 wherein threshold voltage of an output driving
6 connected MOSFET of said BiCMOSFET auxiliary output driver is substantially equivalent
7 to threshold voltage of an output driving MOSFET of said first stage.

8 15. A output driver circuit for an integrated circuit having a V_{DD} power supply operating
9 range, the circuit comprising:

10 MOSFET means for amplifying an input signal to said output driver circuit such that
11 a digital signal state level is output therefrom; and

12 coupled to said means for amplifying, BiCMOS means for maintaining the digital
13 signal state level output by said circuit when V_{DD} power supply voltage falls beneath said
14 V_{DD} power supply voltage operating range, wherein said BiCMOS means for maintaining is
15 inactive when said V_{DD} power supply voltage is within said V_{DD} power supply voltage
16 operating range.